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ABSTRACT

This module is the fourth in a series of 12 learning modules designed to teach occupational mathematics. Blocks of informative material and rules are followed by examples and practice problems. The solutions to the practice problems are found at the end of the module. Specific topics covered include calculator subtraction, order of operations, and subtraction of measurements. (YLB)

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Fundamentals of OCCUPATIONAL MATHEMATICS

Module 4

Calculator Subtraction and Applications

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MODULE 4 -- CALCULATOR SUBTRACTION AND APPLICATIONS

Subtraction is the second of the four basic operations. Subtraction is the operation to use when you need to calculate the **DIFFERENCE** of two numbers.

The key sequence to compute a subtraction on a calculator is shown below.

EXAMPLE 1: Compute the subtraction:

Subtract 43.81
7.39

Solution:

Directions	Key Strokes	Display
Enter 43.81	4 3 . 8 1	43.81
Subtract	-	43.81
Enter 7.39	7 . 3 9	7.39
End Problem	=	36.42

The solution of 43.81 - 7.39 is 36.42

EXAMPLE 2: Fill in the display values which are shown on a calculator as Example 2 is input on the calculator.

Compute 42.875
- 9.989

Solution:

Directions	Key Strokes	Display
Enter 42.875	4 2 . 8 7 5	_____
Subtract	-	
Enter 9.989	9 . 9 8 9	_____
End Problem	=	_____

Addition is a nice operation because of two properties which addition has. These properties allow a person to be careless with number order and addition order without affecting the total. The sums 12 + 5 + 3, 5 + 12 + 3, and 3 + 5 + 12 are all equal to 20. No matter how the number and addition orders are changed, the same sum is obtained.

Subtraction does not possess either of these properties. When a subtraction with two or more numbers is to be performed, the order is important. The subtractions 12 - 5 - 3, 5 - 12 - 3, and 3 - 5 - 12 are all three different amounts. The number and operation order in a subtraction problem must be defined and followed.

EXAMPLE 3: What is the result of subtracting 17.82 from 41.09?

Solution:

Order of subtraction is 41.09 - 17.82

Directions	Key Strokes	Display
Enter 41.09	4 1 . 0 9	41.09
Subtract	-	41.09
Enter 17.82	1 7 . 8 2	17.82
End problem	=	23.27

The solution is 23.27

PRACTIC PROBLEMS: Compute the indicated differences and sums:

1. Subtract 284.3 − 12.98

2. Subtract 243.178 − 98.205

3. Add 78.19 + 2.483

4. Subtract 76.815 − 2.483

5. Add 97.1806 + 34.0725

6. Calculate 0.09021 − 0.00753

7. Calculate 793.8 - 49.6

8. Calculate 5.87 - 0.956

9. Calculate 43.26 + 19.07

10. Calculate 9,832 - 4,975

Calculation problems which contain several operations that must be performed are written and worked in a specific order. To understand why there must be an agreement on the order of performing a series of operations, consider the problem of calculating 15 - 8 + 2. Two operations need to be performed; a subtraction and an addition. The two orders in which this pair of operations can be performed are shown in these cases.

CASE 1: Subtract first and then add
$15 - 8 + 2 = 7 + 2$
$= 9$

CASE 2: Add first and then subtract
$15 - 8 + 2 = 15 - 10$
$= 5$

If both answers were considered correct, then every job which deals with design would fall into chaos. The person who writes problems and the person who has to solve the problems need to have an agreement about how a series of operations is to be ordered. The rule, called "Order of Operations", will say Case 1 was correct; 15 - 8 + 2 = 9. If the author of the problem had intended the answer to be 5, then the problem was not properly written. In order to add first, write 15 - (8 + 2) = 5.

Only part of the rule called "Order of Operations" is outlined here. This preliminary version, covering operations of add and subtract, will be expanded in Lesson 6 and in Lesson 12 to cover other operations.

ORDER OF OPERATIONS RULE FOR ADD and SUBTRACT

1. First do the operations enclosed inside a pair of grouping symbols like parentheses () or braces []. Use rule 2 to select order if more than one operation is enclosed inside a grouping symbol pair.

2. Perform additions and subtractions in the same order as they appear when the problem is read from left to right.

EXAMPLE 4: Calculate 71.3 + 18.62 - 49.50 - 31.24

Solution: There are no grouping symbols so follow the order as described in step 2 of the rule.

Directions	Key Strokes	Display
Enter 71.3	7 1 . 3	71.3
Add	+	71.3
Enter 18.62	1 8 . 6 2	89.92
Subtract	-	89.92
Enter 49.50	4 9 . 5 0	49.5
Subtract	-	40.42
Enter 31.24	3 1 . 2 4	31.24
End problem	=	9.18

EXAMPLE 5: Calculate 76.51 - (35.18 - 16.93)

Solution: The problem to be calculated contains parentheses in which there is one operation (count operations, not the numbers). Step 1 of the order rule is applied first. The subtraction in parentheses is the first operation to perform.The calculator steps below show how to accomplish the required order

Directions	Key Strokes	Display
Enter 35.18	3 5 . 1 8	35.18
Subtract	-	35.18
Enter 16.93	1 6 . 9 3	16.93
End in ( )	=	18.25
Store (value)	STO	18.25
Enter 76.51	7 6 . 5 1	76.51
Subtract	-	76.51
Recall (value)	RCL	18.25
End Problem	=	58.26

EXAMPLE 6: Calculate 65.017 - (9.82 - 5.736 + 12.823) + 9.13

Solution: The value resulting from the operations inside parentheses is always calculated first.

Directions	Key Strokes	Display
Enter 9.82	9 . 8 2	9.82
Subtract	-	9.82
Enter 5.736	5 . 7 3 6	5.736
Add	+	4.084
Enter 12.823	1 2 . 8 2 3	12.823
End in ( )	=	16.907
Store (value)	STO	16.907
Enter 65.017	6 5 . 0 1 7	65.017
Subtract	-	65.017
Recall (value)	RCL	16.907
Add	+	48.11
Enter 9.13	9 . 1 3	9.13
End Problem	=	57.24

PRACTICE PROBLEMS: Calculate the result of the following operations.

11. 2.689 - 1.952 - 0.285

12. 98.7 + 32.95 - 14.82

13. 1.79 + 2.24 - 0.108 - 2.430

14. 2.184 - 1.720 + 36.5 - 9.33

15. 14.815 - 2.630 - 3.075 - 6.912

16. 97.24 + 3.819 - 69.15 + 24.8

17. 36.06 - (4.72 + 9.15)

18. 9.73 - (10.86 - 4.02)

19. 14.06 - (8.15 + 1.26) - 2.91

20. 71.1 + 38 - (43.7 - 15.1)

21. 8020 - (910 + 861 - 435) - 263

22. 0.913 - 0.142 + (0.815 - 0.726)

23. (7.80 - 1.35) - (14.3 - 10.26)

24. 1.6234 - (4.8151 - 1.006 - 3.295)

25. 2.631 - (1.982 + 0.064) - (0.137 + 0.084)

While working through the next few examples and the practice problems which follow, remember this purpose statement. The purpose of these word problems is to become exposed to situations which are solved by addition and subtraction. A student is learning **WHEN** to subtract and **WHEN** to add, not how. After completion of a problem, review the concept which described **WHEN** a particular operation was the one to be used.

The clues encountered that suggest a subtraction operation are situations which indicate a change, an amount leftover or some difference of amounts.

EXAMPLE 7: A bar of 9 mm key stock, originally 1830 mm long, has had pieces 41 mm, 27 mm, and 253 mm cut from it. What is the length of the remaining piece?

Solution: Use steps like those suggested in Lesson 3.

1. Read the problem as many times as needed.
2. The amount leftover is to be computed.
3. The "9 mm" is an unimportant value.
4. Remainder here is amount leftover. That is WHEN subtraction is used.
5. 1830 mm - 41 mm - 27 mm - 253 mm = 1509 mm
6. 1509 mm remains after 3 cutoffs.

Example 7 can also be solved by changing steps 4 and 5.

4. There is a total of 3 cutoffs so problem contains both add and subtract.
5. 1830 mm - (41 mm + 27 mm + 253 mm)
   1830 mm - 321 mm = 1509 mm.

EXAMPLE 8: During his Wednesday shift, Joe completed the following orders: Job #1 - 2,815 pieces, Job #2 - 3,745 pieces and Job #3 - 1,812 pieces. When Joe filled out his production sheet, he incorrectly recorded Job #2 as 3,475 where the tens and hundreds digits were reversed. How much error will there be in his production total.

Solution:

1. Read as often as needed.
2. The error or difference is to be computed.
3. Only the Job #2 numbers show a difference.
4. Finding an amount of difference is WHEN subtract is used.
5. 3745 - 3475 = 270 pieces.
6. The error is 270 pieces.

EXAMPLE 9: Starting weekly wage at Widget Inc. is $210 with increases to $245 and $260 at the end of six and twelve months, respectively. How much is each increase and the total increase during the first year.

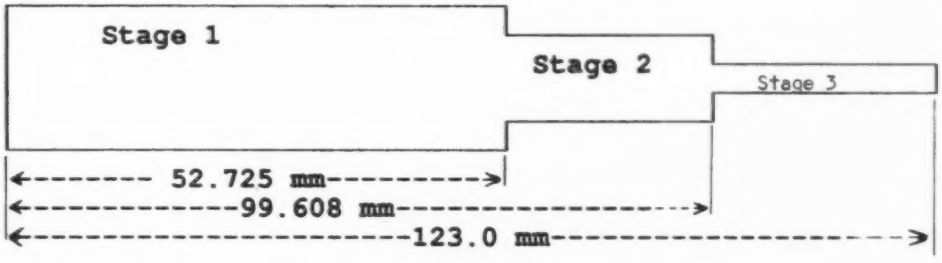
Solution:

1. Read as often as needed.
2. There are two increases and a total increase to compute.
3. Each wage is important.
4. Increase means change and change is WHEN subtract is used.
5. First increase = $245 - 210
   = $35
   Second increase = $260 - 245
   = $15
   Total increase = $35 + $15
   = $50

Guess what happens when the numbers to be added and subtracted are measurements! When measurements of different precisions are to be added or subtracted, the result should not be of greater precision than the least precise of the measurements.

To turn a piece of steel into a pin with the step-down diameter sizes shown in Figure 4.1, the largest diameter is turned first and the smallest diameter turned last. This avoids excessive stress on the smallest diameter portion of the pin.

FIG 4.1



EXAMPLE 10: Find the linear length of the Stage 2 part of the pin of Fig. 4.1.

Solution: Stage 2 length is the change from 52.725 mm to 99.608 mm. Change suggests subtraction.

$$\begin{array}{r} 99.608 \text{ mm} \\ -52.725 \text{ mm} \\ \hline \end{array}$$

These measurements have the same precision, so no rounding needs to be performed to prepare the measurements for subtraction.

$$99.608 \text{ mm} - 52.725 \text{ mm} = 46.883 \text{ mm}$$

Stage 2 length is 46.883 mm

EXAMPLE 11: According to the design specifications, the total length of the three-stage pin in Fig. 4.1 is to be 123.0 mm. Find the linear length of the Stage 3 part.

Solution: Stage 3 length is the difference between 123.0 mm and 99.608 mm. Difference suggests subtraction.

$$\begin{array}{r} 123.0 \text{ mm -- least precise} \\ -99.608 \text{ mm} \\ \hline \end{array}$$

These measurements do not have the same precision. Round the 99.608 mm to the nearest 0.1 mm.

$$\begin{array}{r} 123.0 \text{ mm} \\ -99.6 \text{ mm} \\ \hline 23.4 \text{ mm} \end{array}$$

Stage 3 length needs to be 23.4 mm.

PRACTICE PROBLEMS: Compute the requested amount in each of the following application problems. Apply the rule of measurements when necessary. Correct answers may have a unit of measure with the computed number value.

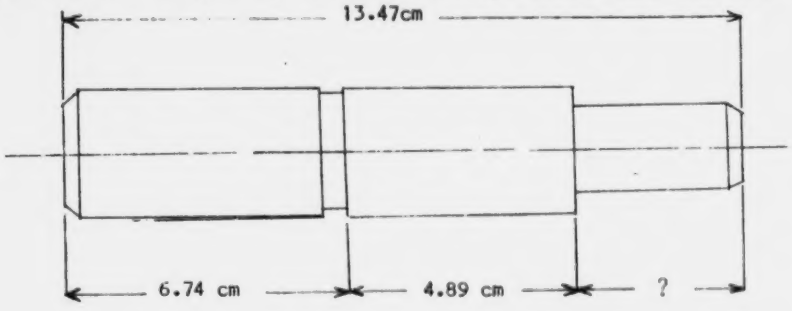
26. How much must the diameter of a 21.50 mm shaft be reduced so that its diameter will be 20.24 mm?

27. What is the difference in thickness between a 0.4375 in. steel plate and a 0.6250 in. steel plate?

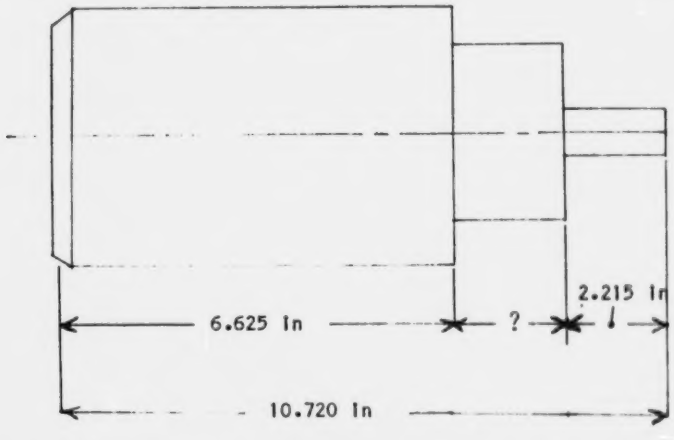
28. A planer takes a 0.0070 in. cut on a plate with each pass. What will be the thickness of an 0.4375 in. thick plate after three passes.

29. A bar of 12 mm key stock, originally 924.5 mm long, has had pieces 24.1 mm, 12.7 mm, and 42.53 mm cut from it. What is the length of the remaining piece.

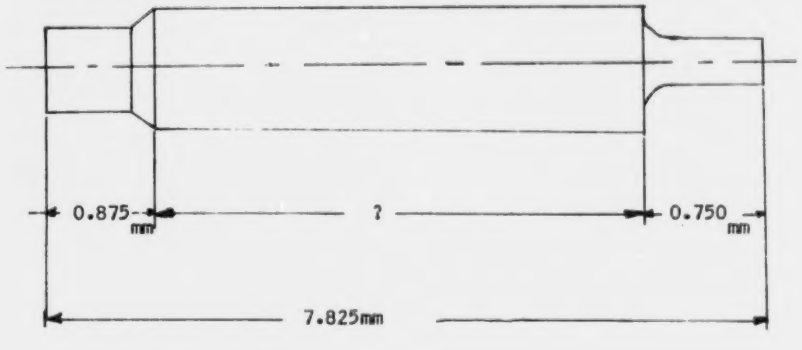
30. Compute the length of the missing dimension in the figure below.



31. Find the length of the missing dimension in the figure below.



32. Calculate the length of the missing dimension in the figure below.



SOLUTIONS TO PRACTICE PROBLEMS -- Module 4

1. 271.32
2. 144.973
3. 80.673
4. 74.332
5. 131.2531
6. 0.08268
7. 744.2
8. 4.914
9. 62.33
10. 4857
11. 0.452
12. 116.83
13. 1.492
14. 27.634
15. 2.198
16. 56.709
17. 22.19
18. 2.89
19. 1.74
20. 80.5
21. 6421
22. 0.86
23. 2.41
24. 1.1093
25. 0.364
26. 1.26 mm
27. 0.1875 in.
28. 0.4165 in.
29. 845.2 mm
30. 1.84 cm
31. 1.880 in.
32. 6.200 mm